Integrated Security Analysis

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CERTS
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Power System Security - Operations

- Current state within limits
- Able to withstand contingencies
  - Satisfy thermal constraints on lines
  - Satisfy voltage constraints at buses
  - Suitable margin to voltage collapse limit
  - Suitable margin to steady-state stability limit
  - Suitable margin to transient stability limit

Security analysis tools

- Power flow program (linear and full)
- Continuation power flow program
- Eigenvalue analysis program
- Transient stability analysis program

Project tasks

- Task 1 Existing security analysis tools
  - Have completed 16 surveys of major organizations
  - Have categorized the tool functions and robustness
  - Have documented existing security analysis tools and identified future needs
  - Have evaluated the technical merits of the tools' algorithms and the current limitations
  - Have collected performance information from operational experience
  - Final documentation is in progress

Survey topics

- General information and EMS software vendor name, version number, operating platform
- Model dimensions, format, neighbor exchange, network reduction, SCADA, Power Flow, State Estimation
- Scan rates, effectiveness/robustness, and issues/plans

Survey topics

- Contingency analysis programs
- Security constrained dispatch
- Optimal Power Flow
- Security Constrained OPF
- Voltage/Var dispatch
- Dynamic and transient stability analysis
- Screening, execution times, issues/plans, effectiveness/robustness,

Organizations surveyed

- American Electric Power
- Baltimore Gas & Electric
- California ISO
- Consolidated Edison
- Commonwealth Edison
- Duke energy
- Florida Power Corp.
- ISO New England
- Kansas City Power & Light
- Mid American Interconnected Network
- Northern States Power (XCEL)
- Ontario Hydro Services
- Rocky Mountain Desert SW Security Center
- Salt River Project
- Southern Company Services
- Southwest Power Pool

Project tasks

- Task 2 Framework for future security analysis tools
  - Have examined new concepts in security analysis with documented results
  - Have examined the functional requirements for a next-generation security analysis tool

New concepts

- Families of feed-forward ANN on-line security estimators
  - Static Security Assessment
  - Voltage Security Assessment
  - Dynamic Security Assessment
  - Offline training
  - Margin estimates based on operating conditions
  - Tested on a modified 39-bus New England system and 8,000 bus WSCC system

Project tasks

- Task 3 Inventory existing visualization development activities
  - Collecting information from ongoing visualization development activities
  - Evaluating applicability to future security analysis tools
  - Identifying future visualization tools that will assist operators in decision processes

Project tasks

- Task 4 Develop a roadmap for developing a next generation security analysis tool
  - Have identified the primary gaps in the existing tools
  - Have identified the key technology development hurdles for enhancing the current generation of tools
  - Have identified existing technology developments that can be leveraged in this development
  - Documentation is in progress

Gaps and hurdles in tools

- Coordinated alarm processing, remedial action schemes, and decision tools
- Systematic fault current analysis based on real-time topology and proposed switching
- Lack of critical external data
- Functional voltage/var dispatch

Gaps and hurdles in tools

- Operator DSA
- Functional security-constrained OPF
- On-line operational guidelines updates
- Risk-based contingency processing
- Systematic incorporation of uncertainty
- Accurate prediction technologies

Remaining work

- Organize the survey results in report format
- Summarize results of new concepts
- Complete the inventory of visualization tools
- Complete the roadmap for the next generation security analysis tool
- Complete the final report